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K. Hurley, J. H. Primbsch, P. Berg, K. Ziock
I. Mitrofanov, D. Anfimov, A. Chernenko, V. Dolidze, V. Loznikov,
A. Pozanenko, A. Tonshev, D. Ushakov, T. Cline, R. Baker, D. Stilwell,
D. Sheppard, N. Madden

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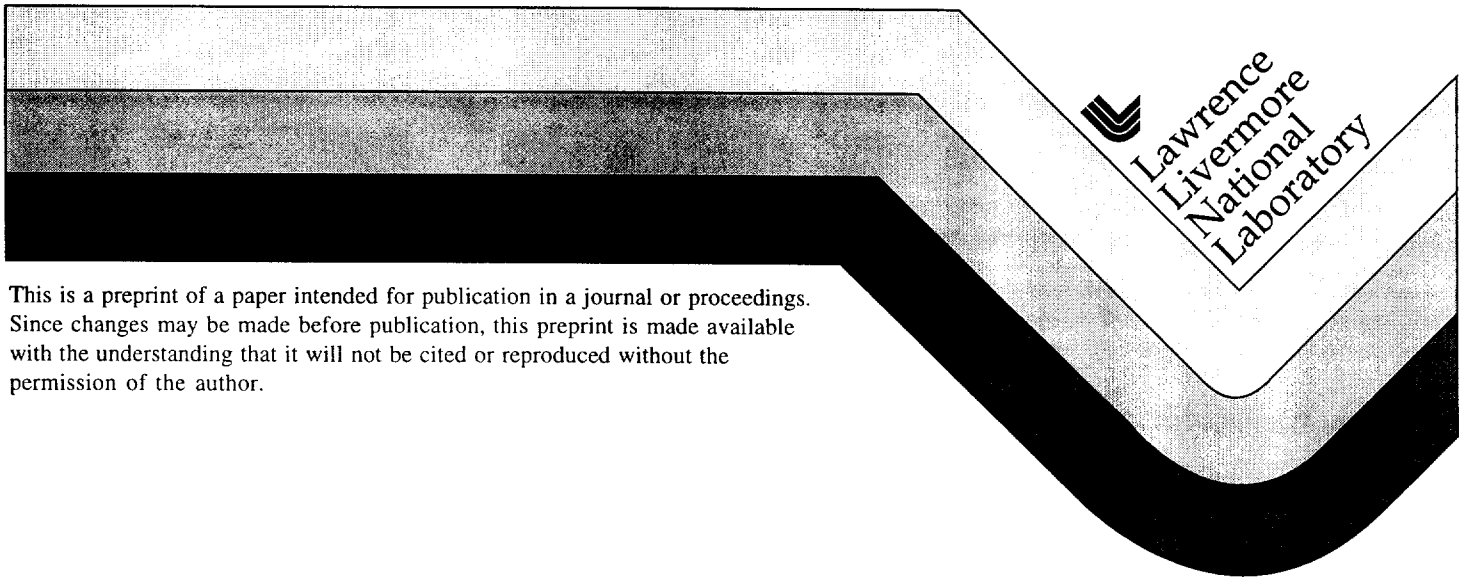

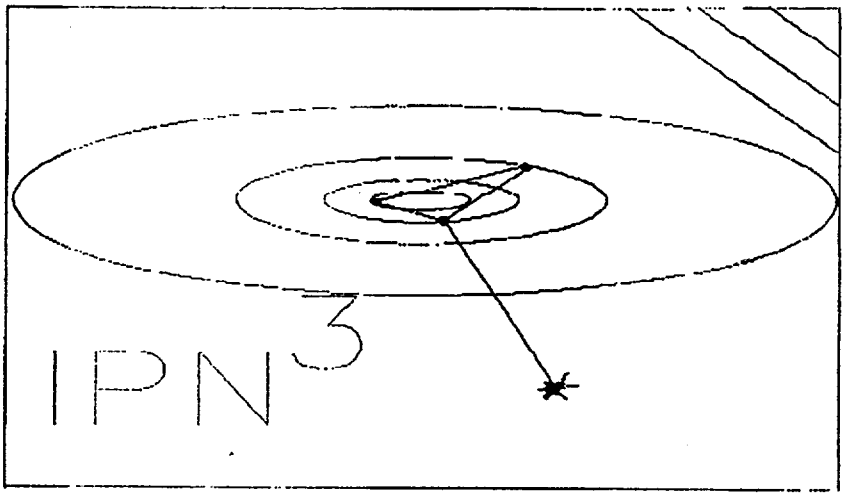

University of California at Berkeley Space Sciences Laboratory

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K. Hurley, J.H. Primbsch, P. Berg
U.C. Berkeley Space Sciences Laboratory
Berkeley, CA 94720-7450

K. Ziock
Lawrence Livermore National Laboratory
L-296
Livermore, CA 94550

I. Mitrofanov, D. Anfimov, A. Chernenko, V. Dolidze, V. Loznikov, A. Pozanenko, A. Tonshev, D. Ushakov
Institute for Space Research
Profsoyouznaya 34/32, 117810 Moscow

T. Cline, R. Baker, D. Stilwell, D. Sheppard
NASA Goddard Space Flight Center
Greenbelt, MD 20771

N. Madden
Lawrence Berkeley Laboratory
29-204
Berkeley, CA 94720

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Abstract

The renewal of the Ulysses mission to the year 2001, and the failure of Mars Observer, once more leave the Interplanetary Network with only two widely spaced components. We have therefore developed and begun to build a small GRB detector for the Russian Mars '96 mission. A prototype has now been delivered to Russia for spacecraft tests. Three interesting features of this experiment are first, that it measures both particles and gamma rays, second, that it is not much larger than a Walkman (hence the name), and third, that it is being constructed with support only from discretionary funds at a number of institutes. We discuss the types of measurements that Burstman will make, as well as the quantity and quality of the small error boxes that will be obtained during the two year (nominal) Mars '96 mission.

Introduction

The third interplanetary network has been without a distant third spacecraft since the loss of Mars Observer in 1993. Since the Ulysses mission will operate until 2001, and the Compton Gamma-Ray Observatory will be extended for at least a few more years, we have begun development of a small burst detector which will be proposed for future planetary missions. Its first flight will be on the Russian Mars '96 spacecraft, to be launched in November 1996.

The prototype version of this experiment, which we call Burstman, was developed in only a year, using discretionary funding from the California Space Institute, the Institute for Geophysics and Planetary Physics, Lawrence Livermore National Laboratory, Goddard Space Flight Center, and Lawrence Berkeley Laboratory. To enhance the scientific return from outer planet missions, we have designed it to detect and distinguish both energetic particles, such as electrons and protons, and photons.

Characteristics and Expected Performance

The essential physical characteristics of the experiment are the following: its dimensions are 150 x 190 x 75 mm, its mass is 750 g, and it consumes 550 mW of power, excluding the heater. It should be possible to reduce the size, and perhaps the mass, of future versions with more development effort. The sensor consists of a CsI/plastic phoswich; each layer is 3 mm thick, and the surface area is 20 cm^2. The overall design is loosely based on that of the Ulysses GRB experiment (Hurley et al. 1992). The sensor is the responsibility of Lawrence Livermore National Laboratory; the analog electronics was designed and built at Lawrence Berkeley Laboratory and the Space Sciences Laboratory, while the digital electronics and ground support equipment were developed and built at Goddard Space Flight Center. The prototype is shown in Figure 1.

The experiment has numerous operating modes and can adapt to various telemetry rates starting around 40 b/s. Configured for the Mars '96 mission, it returns particle rates (but not energy spectra) with time resolution 0.25 s, gamma-ray burst rates with high time

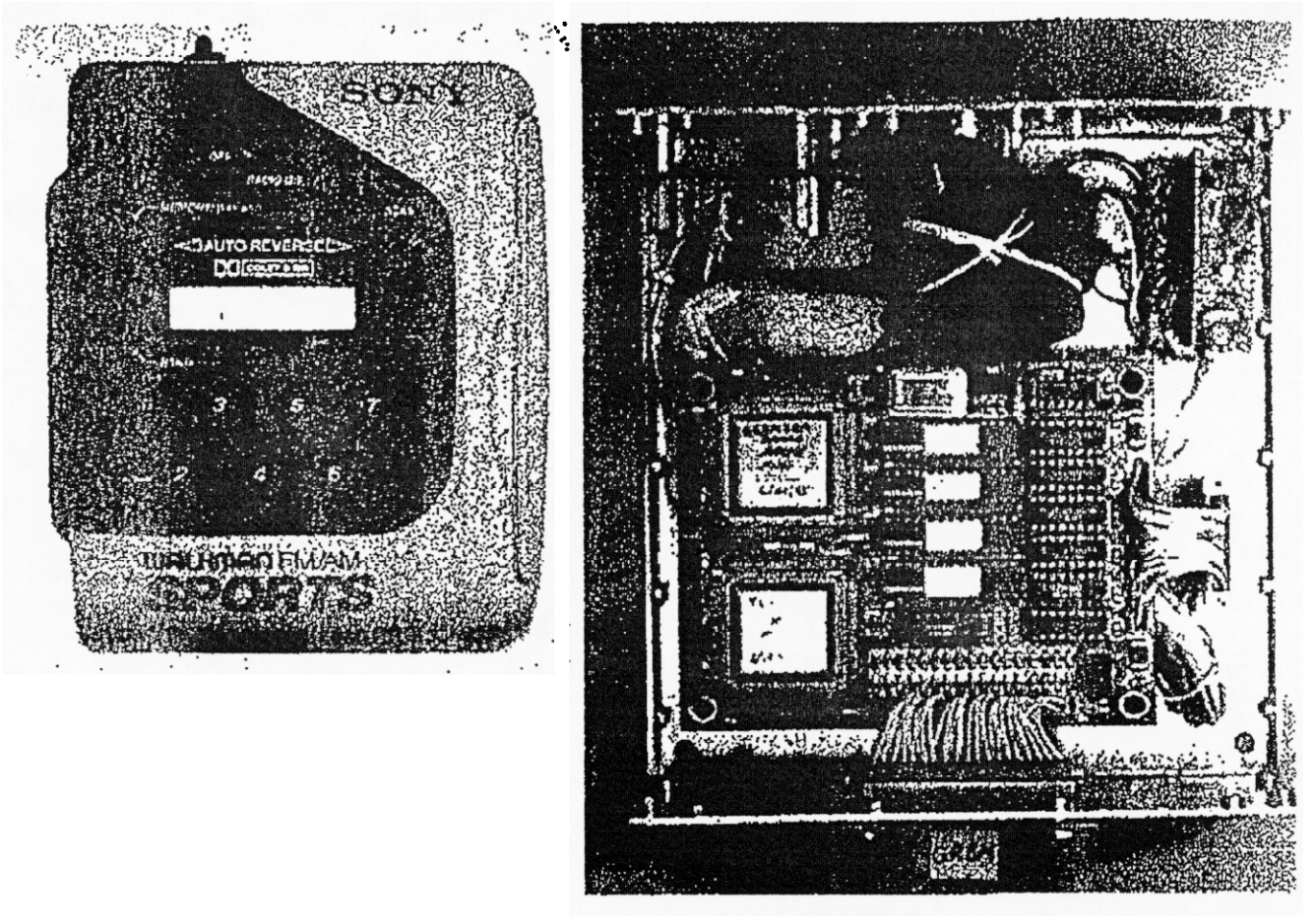

Figure 1. Walkman (left) and Burstman (right).

resolution (typically 8 ms following a trigger), and energy spectra with coarser resolution. The nominal energy range for photons is 25-150 keV. The Mars '96 version has a single sensor unit (as opposed to two sensor units aboard Ulysses) and thus will cover 2π sr with good efficiency, and another 2π sr with reduced efficiency. We anticipate that the trigger threshold for bursts will be $\sim 10^{-6}$ erg cm^{-2}. Bursts can also be detected in the real-time (untriggered) photon data, with resolution ~0.25 s. Scaling from the Ulysses burst detection rate, we expect to detect approximately 100 cosmic events/year.

Conclusions

As of this writing, the prototype detector has been integrated aboard the Mars '96 spacecraft. The first flight unit is undergoing qualification testing, and will be delivered to Moscow in November 1995. A second flight unit will then be fabricated.

The nominal Mars '96 mission duration is two years. Thus between 1996 and 1998, the 3rd Interplanetary Network will consist of Ulysses, Mars '96, CGRO, Wind, and other near-Earth missions. At the launch of Mars '96, Ulysses will be 4.8 AU from Earth; its distance will reach 6.2 AU within less than one year. Mars '96 will reach distances of

2.4 AU from Earth. Thus for bright bursts and favorable geometries, many of the two hundred events detected will be localized to arcminute accuracies and better.

Acknowledgments

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Reference

Hurley, K., et al., Astron. Astrophys. Supp. Ser. 92(2), 401, 1995